

526,450

10/526450

Rec'd PCT/PTO 02 MAR 2005

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
18 March 2004 (18.03.2004)

PCT

(10) International Publication Number
WO 2004/023334 A1

(51) International Patent Classification⁷: G06F 17/30

(72) Inventors; and

(21) International Application Number:

PCT/EP2003/009472

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(22) International Filing Date: 27 August 2003 (27.08.2003)

(25) Filing Language:

English

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(26) Publication Language:

English

(81) Designated States (national): JP, US.

(30) Priority Data:

02019777.8

4 September 2002 (04.09.2002) EP

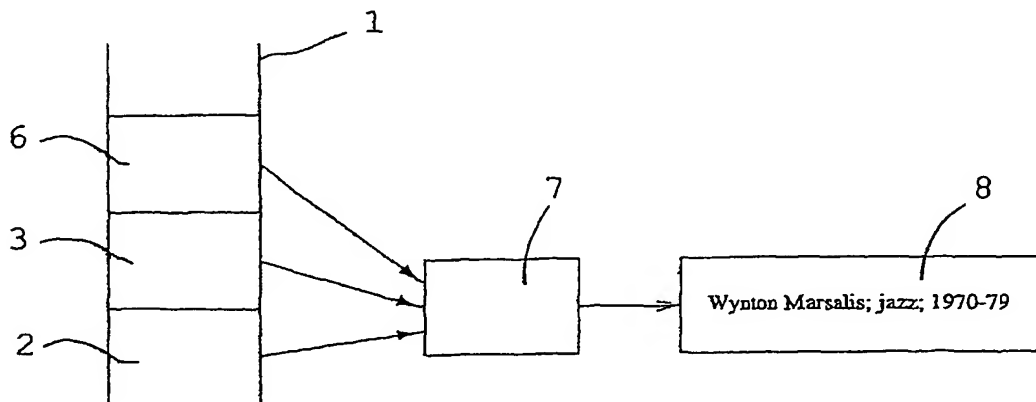
Published:

— with international search report

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DATABASE QUERY SET-UP TOOL AND METHOD FOR SETTING UP A QUERY



(57) Abstract: A database query set-up unit comprising a contribution stack and means for deriving a current information state from said contribution stack is described. Any search criteria provided by any user or by the system itself is pushed onto said contribution stack in the order of occurrence. The current information state, which is used for actually accessing the database, is formed from a subset of the set of search criteria contained in said contribution stack. In order to relax the search constraints, it is possible to suppress one or more of the search criteria contained in said contribution stack when forming the current information state. By implementing a contribution stack, it is possible to keep track of the order of occurrence of the various user inputs and system contributions, and to use this information for relaxing the search constraints.

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1 **Database Query Set-up Tool and Method for Setting up a Query**

 The invention is related to a database query set-up unit for combining a set
of search criteria in order to set up a database query, and to a method for
5 setting up database queries by combining a set of search criteria.

 In a dialogue system for database access, the user is mainly specifying the
search criteria for a database request. This does not only include specifica-
tion of the search criteria but it may also involve change or relaxation of
10 said search criteria. The information of what has been achieved in the dia-
logue so far is called the information state, and in this particular setting,
the information state comprises the search criteria. In order to obtain ade-
quate recognition rates in speech recognition and language understanding
and integrate newly added information into the system, the system needs to
15 restrict and structure the information given by the user. For this purpose,
a hierarchy of data is necessary, which reflects the dependencies which
hold between the units of the given information.

 Most state of the art dialogue systems retrieve such a hierarchy from the
20 structure of the domain. Ill-structured tasks [Bernsen, N. O. and Dybkjaer,
L.: From single word to natural dialogue. Invited book chapter in Zelkowitz,
M. V. (Ed.): Advances in Computers, Vol. 52. London: Academic Press 2000,
267-327, section 3.9.2] explore a domain that does not provide a naturally
given structure; in case dialogue systems have to cope with such an ill-
25 structured task, current state of the art systems either impose an unnatu-
ral hierarchy onto the domain and assist the user finding his way through
this hierarchy [TrindiKit: Staffan Larsson, Robin Cooper, Stina Ericsson
(2001): menu2dialog. In Jokinen (Ed.): Knowledge and Reasoning in Practi-
cal Dialogue Systems, Workshop Program, IJCAI-2001] or they take an in-
30 cremental approach [Embassi: Bernd Ludwig, Günther Görz, Heinrich Nie-
mann, An Inference-based Approach to the Interpretation of Discourse,
Special Issue of the Journal of Language and Computation, Volume 1,
Number 2, 2000, pp. 241-258].

35 The incremental approach classifies any new information that is added to
the current information state as dependent on the current (unaugmented)
information state; it does not postulate an unnatural hierarchy. Thus, if

1 only a part of the information state is overwritten in a further step, the la-
test information is deleted, since it depends on the entire information state
and so it also depends on that part. This behaviour is implemented by kee-
ping a history of information states; if a previous information state is resto-
5 red, all information that has been added subsequently is lost.

It is an object of the invention to combine a set of search criteria for perfor-
ming a database query in a more flexible way, in order to allow for a relaxa-
tion of said search criteria.

10

The object of the invention is solved by a database query set-up unit for
combining a set of search criteria in order to set up a database query ac-
cording to claim 1, and by a method for setting up database queries by
combining a set of search criteria according to claim 15. Preferred embodi-
15 ments thereof are respectively defined in the following dependent sub-
claims. A computer program product according to the present invention is
defined in claim 28.

20

In the database query set-up unit according to the invention, a set of
search criteria is combined in order to set up a database query. The da-
tabase query set-up unit comprises a contribution stack, in which search
criteria provided by at least one user or by the system itself are stored in
the order of occurrence. Each new search criterion provided by said at least
one user is pushed onto said contribution stack. Furthermore, the da-
25 tabase query set-up unit comprises means for deriving a current informa-
tion state from said contribution stack, whereby said current information
state is formed from a subset of the set of search criteria contained in said
contribution stack. Said current information state is used for accessing a
database.

30

In prior art solutions, the various search criteria provided by a user are im-
mediately combined to form an information state, and the database is ac-
cessed according to said information state. When said information state is
formed, the order in which the user has input the search criteria is lost.
35 The hierarchy defined by the sequence of user inputs is no longer available.
In order to maintain the information about the order in which said search
criteria have been provided, a contribution stack is used for storing said

1 search criteria. Whenever an attribute, a keyword or another kind of search
constraint is entered by the user, said search criterion is pushed onto the
contribution stack. After a set of search criteria has been entered, the ol-
dest search criterion can be found at the bottom of the contribution stack.
5 Recently entered search constraints, which have recently been pushed onto
the contribution stack, can be found on top of the stack. Thus, the order of
the entries within the stack corresponds to the order of occurrence of said
search criteria. This holds true even in case said search criteria are not
only provided by one single user, but by several users, or partly by said us-
10 ers and partly by the system itself. The invention allows the user to freely
provide input without being restricted by preceding specifications.

Starting from the entries within the contribution stack, a current informa-
tion state is derived. Said current information state is then used for actual-
15 ly accessing the database. Of course, it is possible to utilize the whole set
of entries within the contribution stack for forming the current information
state. By combining all the search criteria that have been entered so far,
the resulting query might be too narrow, though, and the number of hits
within the database might be very small or even zero. In this case, the
20 search result is not very valuable for the user.

In such a situation, it is desirable to relax the search criteria in order to in-
crease the number of hits. For obtaining valuable search results, it is very
important to use powerful relaxation strategies that relax said search crite-
25 ria in a way that the query still reflects what the user intends to search for.
For relaxing the search constraints, it is necessary to leave out one or more
of the entries in the contribution stack when forming the current informa-
tion state. Broadening the scope of a query therefore implies that a subset
of the set of search criteria contained in the contribution stack is chosen.
30 By using the contribution stack according to the invention, it is possible to
define relaxation strategies that consider the order in which said search
criteria have been provided. For example, the relaxation strategy could be
to ignore the oldest search criterion at the very bottom of the contribution
stack when deriving the current information state. In prior art solutions, it
35 has not been possible to keep track of the order of occurrence of the search
criteria, and therefore, it has not been possible to relax the search in de-
pendence of said order.

1 The query that has been set up by relaxing the initial set of search con-
straints might not be successful either. In case the initial entries in the
contribution stack are still available and have not been erased yet, it is
possible to form a second current information state from the initial set of
5 search criteria, whereby at this time, a different relaxation strategy is used.
When this second current information state is used for accessing the da-
tabase, this second query might yield an acceptable result.

Preferably, the order in which said search criteria are provided by said at
10 least one user or by the system determines a hierarchy of dependencies
between said search criteria. Predefined hierarchies of dependencies be-
tween different search criteria and search attributes are not used in the so-
lution according to the invention. Instead, the hierarchy of dependencies is
dynamically defined by the user input. The order in which the user enters
15 the various search criteria defines the hierarchy of said search criteria. The
search criterion that is provided first has the highest level in the hierarchy.
All search criteria that are input afterwards depend on said search crite-
rion. Thus, the dependencies between said search criteria are defined by
the order of occurrence.

20 According to a preferred embodiment of the invention, each time a new
search criterion is provided, it is checked whether said new search criterion
refers to an attribute that has already been specified by an earlier search
criterion stored in said contribution stack. For a certain query, each search
25 attribute only has to be specified once. When the user provides two diffe-
rent specifications for a certain search attribute, then these two specifica-
tions contradict each other. The search criteria are not coherent in this
case. For example, when performing a query for German literature, it does
not make sense to specify the search attribute "author" more than once.
30 When a user specifies a certain search attribute for the second time, the
database query set-up unit's interpretation is that the user wants to cor-
rect an input that has been made earlier. For this reason it has to be
checked each time a new search criterion is provided whether said new
search criterion refers to an attribute that has already been specified ear-
35 lier.

Preferably, in case said new search criterion refers to an attribute that has

- 5 -

1 already been specified by an earlier search criterion stored in said contri-
bution stack, said earlier search criterion is erased from said contribution
stack, and said new search criterion is pushed onto said contribution
stack. This is the first method for overwriting a search attribute that has
5 been specified earlier. In order to set up a coherent query, the earlier
search criterion, which is stored at some location within the contribution
stack, is erased. Said new search criterion is pushed onto the contribution
stack. All the search criteria stored at intermediate positions between said
earlier search criterion and said new search criterion are maintained.
10 Therefore, in the first method of overwriting, these intermediate entries are
not lost. Another advantage is that the new search criterion is written to a
location within the contribution stack that corresponds to the order of oc-
currence of said new search criterion.

15 Alternatively, in case said new search criterion refers to an attribute that
has already been specified by an earlier search criterion stored in said con-
tribution stack, said earlier search criterion and all search criteria that
have been pushed onto the contribution stack afterwards are popped from
said contribution stack, and said new search criterion is pushed onto said
20 contribution stack. This is the second method for overwriting a search cri-
terion that has been provided earlier. Again, the earlier search criterion is
erased from the contribution stack, and the new search criterion is pushed
onto the contribution stack. According to this second method, the interme-
diate entries between the earlier search criterion and the new search crite-
25 rion are erased as well, because they depend on the earlier search criterion
which is not valid anymore. The search criterion specified by the user is
written exactly to the stack position where said earlier search criterion has
been stored. Then, the following contributions given either by the user or
the system fill up the consecutive stack positions. According to this ap-
30 proach, the intermediate stack entries are erased.

Preferably, the database query set-up unit comprises means for relaxing
the search constraints of a database query which suppress at least one of
said search criteria contained in said contribution stack when said current
35 information state is derived. In case a query comprises too many search
criteria, a very limited search result is obtained. In this case, it is advanta-
geous to suppress one or more of said search criteria when forming said

1 current information state. This does not necessarily imply that the
suppressed search criteria are also erased from the contribution stack. Af-
ter the search constraints have been relaxed, the system presents a wider
range of the respective database to the user.

5

Preferably, said means for relaxing the search constraints of a database
query select the search criteria to be suppressed according to the order of
occurrence, and/or according to user profiles, and/or according to context
information. By considering some or all of these aspects, it is possible to
10 relax the search constraints in a way that the thus obtained search result
corresponds closely to the needs and expectations of the user. By consid-
ering the order of occurrence of said search criteria, a user's profile, and
context information that has been obtained so far, it is possible to set up a
relaxation strategy.

15

Preferably, at least the most recent search criterion stored in said contribu-
tion stack is suppressed when said current information state is derived.
Here, the search criterion to be suppressed is selected according to the or-
der of occurrence: the search criterion that has most recently been pushed
20 onto the contribution stack is suppressed. The last input of the user is
considered the least relevant input here.

Alternatively or additionally, at least the oldest search criterion stored in
said contribution stack is suppressed when said current information state
25 is derived. Again, the relaxation is performed according to the order of oc-
currence of the search criteria. Though the oldest search criterion corre-
sponds to the uppermost level of the dependency hierarchy, it is assumed
that the user has made this input a long time ago and that he might not
even remember said oldest search criterion anymore. Due to this fading
30 memory of the user, contributions that have been provided recently are
considered more relevant.

According to a preferred embodiment of the invention, search criteria that
are suppressed when said current information state is derived are erased
35 from said contribution stack. According to this embodiment, the query that
has been performed based on the current information state corresponds
exactly to the state of the contribution stack. Both in the current informa-

1 tion state and in the contribution stack selected search criteria have been
taken away. The user can now specify new search criteria which are pushed
onto the contribution stack.

5 According to an alternative preferred embodiment of the invention, search
criteria that are suppressed when said current information state is derived
are only erased from said contribution stack when it turns out that the
query yields a valuable result. As long as it is not yet clear whether the re-
10 laxation strategy leads to a sensible result, all the search criteria are main-
tained within said contribution stack. If the relaxation strategy that has
been chosen is not successful, it is still possible to try another relaxation
strategy. In this second relaxation strategy, the search criteria that have
been suppressed during the first approach might become relevant again.
Therefore, it is advantageous not to erase these contributions too early.

15 According to a third preferred embodiment of the invention, search criteria
that are suppressed when said current information state is derived are
maintained within said contribution stack. Here, all the input provided by
the user is always available in chronological order, and no information is
20 lost. From said user input, any desired current information state can be
derived at any time.

Preferably, said search criteria are obtained by means of an interactive
system based on an artificial language, preferably based on a database
25 query language. A simple example for such a database query language is
the language which only consists of attribute value pairs corresponding to
the database.

Alternatively, said search criteria are obtained from said at least one user
30 by means of a natural language dialogue system. The user specifies the
search criteria for the query as a natural language input. Here, the user
has a lot of freedom how to specify his query. Especially for spoken lan-
guage systems that employ some kind of speech recognition, natural lan-
guage dialogue systems are the preferred method for obtaining user input.

35 The inventive method is a method for setting up database queries by combi-
ning a set of search criteria. In a first step, search criteria provided by at

1 least one user or by the system itself are pushed onto a contribution stack
in the order of occurrence. In the next step, a current information state is
derived from said contribution stack, whereby said current information sta-
te is formed from a subset of the set of search criteria contained in said
5 contribution stack. Next, a database query corresponding to said current
information state is set up.

Further features and advantages of preferred embodiments according to the
present invention will be explained below in conjunction with the accom-
10 panying drawings, in which

Fig. 1 shows a contribution stack according to the invention;

15 **Fig. 2** shows a contribution stack containing four search criteria;

Fig. 3A shows the contribution stack after the entry 4 has been
overwritten according to a first method for overwriting an
entry;

20 **Fig. 3B** shows the contribution stack after the entry 4 has been
overwritten according to a second method for overwriting an
entry;

25 **Fig. 4** shows how the entries contained in the contribution stack are
used for deriving a current information state;

Fig. 5 depicts how the search constraints can be relaxed by
suppressing the most recent entry;

30 **Fig. 6A** shows how the search constraints can be relaxed by
suppressing the oldest entry;

Fig. 6B shows the state of the contribution stack when the suppressed
entry is maintained; and

35 **Fig. 6C** shows the state of the contribution stack when the suppressed
entry is erased from the contribution stack.

1 In the following, the invention will be explained by means of several
examples. Let us assume that a music title database is accessed via a spo-
ken dialogue system. For each item in said database, a set of attributes is
provided. In our example, let us assume that there are attributes indicating
5 the genre, the artist, the time period, the song type and the title name. For
each of the items within the music title database, each of said attributes
has been specified and is stored within the database.

10 In Fig. 1, a contribution stack 1 according to the invention is shown. Now,
the user starts setting up his query. There is no predefined hierarchy of the
different attributes (genre, artist, time period, song type, title name), and
therefore, the user can specify any attribute he wants. In our case, the user
first specifies that he or she is interested in music from Wynton Marsalis.
15 The search criterion "artist: Wynton Marsalis" is pushed onto the contribu-
tion stack, as it is shown in Fig. 1. The bottom entry 2 of the contribution
stack 1 therefore contains the search criterion "artist: Wynton Marsalis". In
order to continue setting up the query, the user now specifies that he is in-
terested in the genre Jazz. Therefore, the search criterion "genre: Jazz" is
pushed as a further entry 3 onto the contribution stack 1. The hierarchy
20 between the different search criteria is dynamically defined during the
course of user inputs. The hierarchy of dependencies between the various
search criteria depends on the order in which these search criteria are pro-
vided by the user. For this reason, the search criterion "genre: Jazz" de-
pends on the search criterion "artist: Wynton Marsalis".

25 In our example, the next input provided by the user is "time period: 1960 -
69". The attribute "time period" has not been specified by any search crite-
rion provided earlier, and therefore, there are no conflicts. The new search
criterion "time period: 1960 - 69" is therefore pushed, as an entry 4, onto
30 the contribution stack 1. Next, the user specifies that he is interested in
the song type "ballads". The system checks whether the attribute "song
type" has already been provided. This is not the case, and therefore, the
search criterion "song type: ballads" is pushed, as an entry 5, onto the con-
tribution stack 1. The contribution stack 1, together with the entries 2, 3,
35 4, 5, is depicted in Fig. 2.

The user continues setting up the query by providing "time period: 1970 -

1 79" as a next search criterion. The database query set-up unit checks whether the attribute "time period" has already been specified earlier, and detects that in entry 4, "1960 - 69" has been specified as the relevant time period. The two user inputs for the attribute "time period" contradict, and
5 the query is not coherent anymore. In order to resolve the contradiction, the system assumes that the most recent input provided by the user represents what the user is interested in. Therefore, it is assumed that the user is no longer interested in music from the time period 1960 - 69, and that he is instead interested in music from the time period 1970 - 79. Therefore,
10 the entry 4 containing the search criterion "time period: 1960 - 69" has to be overwritten.

In Fig. 3A, a first method for overwriting a former entry is indicated. According to this method, the entry 4, in which the attribute "time period" has
15 been set to "1960 - 69", is erased from the contribution stack 1. The new search criterion "time period: 1970 - 79" is pushed, as an entry 6, onto the contribution stack 1. Between the former entry 4 and the new entry 6, there exists an intermediate entry 5 "song type: ballads". Though this entry 5 depends on the entry 4, which has been erased from the contribution
20 stack 1, the entry 5 is maintained in the contribution stack 1. This can be seen in Fig. 3A. Maintaining said intermediate entry 5 has the advantage that the user doesn't have to specify the attribute "song type" again. It can be also seen from Fig. 3A that the order of the entries 2, 3, 5, 6 in the contribution stack 1 still represents the chronological order in which the user
25 has specified the various search criteria.

According to a second method for overwriting a former entry, all the intermediate entries between said former entry 4 and a new entry specifying the same attribute "time period" are erased as well. The reason for doing this is
30 that said intermediate entries, for example the entry 5 "song type: ballads", depend on the entry 4 "time period: 1960 - 69", which has to be erased. According to the second method of overwriting a former entry, all the intermediate entries are popped from the stack, and then, the entry that is to be overwritten is popped from the contribution stack. This means that both
35 the entry 5 "song type: ballads" and the entry 4 "time period: 1960 - 69" have to be popped from the contribution stack 1 before the new entry 6, "time period: 1970 - 79" can be pushed onto the contribution stack 1. The

1 state of the contribution stack after said second method for overwriting a
former entry has been performed is shown in Fig. 3B. Both with said first
method and with said second method for overwriting a former entry it is
possible to obtain a coherent contribution stack 1. As can be seen from Fig.
5 3B, the chronological order of the entries 2, 3, 6 is still preserved.

In Fig. 4, it is shown how the entries 2, 3, 6 contained in the contribution
stack 1 are used for deriving a current information state. The entries 2, 3,
6 are forwarded to means 7 for providing a current information state. The
10 search criteria "artist: Wynton Marsalis", "genre: Jazz" and "time period:
1970 - 79" are combined, by said means 7, into a current information state
8. Said current information state 8 is then used for actually performing the
query within the music title database.

15 Let us assume that the query with the search criteria "Wynton Marsalis,
jazz, 1970-79" does not deliver a sufficient number of hits. In this case, the
scope of the query has to be broadened by relaxing the search constraints
that have been provided so far. In order to relax the search constraints, one
or more of the search criteria "artist: Wynton Marsalis", "genre: jazz" and
20 "time period: 1970-79" have to be suppressed.

An example of how the search constraints can be relaxed is shown in Fig.
5. Initially, the entries 2, 3, 6 ("artist: Wynton Marsalis", "genre: jazz",
"time period: 1970-79") are contained in the contribution stack 1. These
25 entries 2, 3, 6 are forwarded to means 9 for deriving a current information
state, which comprise means for relaxing the search constraints in case a
previous query has not yielded acceptable results. In the case shown in Fig.
5, the entry that has been pushed onto the contribution stack most re-
cently is suppressed. Thus, the entry 6 specifying the search criterion "time
30 period: 1970-79" is suppressed, and the current information state 10 gene-
rated by said means 9 comprises the search criteria "Wynton Marsalis,
jazz". With this relaxed subset of search criteria, a new query is carried
out, which might yield a better result.

35 Suppressing an entry when generating a current information state does not
necessarily imply that the respective entry, in the case of Fig. 5 the entry 6,
has to be erased from the contribution stack. Erasing the entry 6, "time pe-

1 riod: 1970-79" can be postponed until it has turned out that the query has
been successful, because in case the query has not been successful, the
entry 6 might still be required for forming a different current information
state. Of course, it is also possible to erase the entry 6 immediately, in or-
5 der to establish a correspondence between the query and the underlying
contribution stack. A third method is to maintain the entry 6 within the
contribution stack 1. In this case, the contribution stack 1 always contains
all the user inputs in chronological order and can repeatedly be accessed
for generating different current information states.

10

In the example given in Fig. 6A, a different strategy for relaxing the search
criteria is used. Again, the contribution stack 1 contains the three entries
2, 3, 6, which comprise the search criteria "artist: Wynton Marsalis",
"genre: jazz", and "time period: 1970-79". Said entries 2, 3, 6 are forwarded
15 to means 11 for deriving a current information state, which comprise me-
ans for relaxing the search constraints. In the example shown in Fig. 6A, a
different relaxation strategy is used, because now, the oldest entry within
the stack is ignored. The entry 2, "artist: Wynton Marsalis" is suppressed,
and the current information state 12 comprises the search criteria "jazz,
20 1970-79" contained in the entries 3 and 6.

20

In Fig. 6B, the state of the contribution stack 1 is shown for the case that
the entry 2 that has been suppressed is maintained within the contribution
stack 1. Fig. 6C shows the state of the contribution stack for the case that
25 the suppressed entry 2 is erased from the contribution stack 1.

25

Generally, any relaxation strategy can be used for broadening the scope of
the query defined by the search criteria within the contribution stack. One
could suppress any entry, as for instance the most recent entry (cf. Fig. 5)
30 or the oldest entry (cf. Fig. 6A). In both cases, the entry that is to be
suppressed is selected according to the order in which said entries have
been provided by the user. These strategies can only be applied when said
order is known. When a contribution stack is employed, the order of occur-
rence of the search criteria is known.

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When selecting the entries that are suppressed it is also possible to consi-
der a user's profile and other kinds of context information. The aim of the

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1 respective relaxation strategy is that though the query as initially specified
by the user has not been successful, the user is provided with the results
of a query that gets close to his or her intentions.

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Claims

1. Database query set-up unit for combining a set of search criteria in order to set up a database query, **characterized by**
- 5 a contribution stack (1) for storing search criteria provided by at least one user or by the system itself in the order of occurrence, whereby each new search criterion provided by said at least one user or by the system is pushed onto said contribution stack (1), and
- 10 means (7, 9, 11) for deriving a current information state (8, 10, 12) from said contribution stack (1), whereby said current information state is formed from a subset of the set of search criteria contained in said contribution stack (1), and whereby said current information state (8, 10, 12) is used for accessing a database.
- 15 2. Database query set-up unit according to claim 1, **characterized in that** the order in which said search criteria are provided by said at least one user or by the system determines a hierarchy of dependencies between said search criteria.
- 20 3. Database query set-up unit according to claim 1 or 2, **characterized in that** each time a new search criterion is provided, it is checked whether said new search criterion refers to an attribute that has already been specified by an earlier search criterion stored in said contribution stack.
- 25 4. Database query set-up unit according to claim 3, **characterized in that**, in case said new search criterion refers to an attribute that has already been specified by an earlier search criterion stored in said contribution stack, said earlier search criterion is erased from said contribution stack, and said new search criterion is pushed onto said contribution stack.
- 30 5. Database query set-up unit according to claim 3, **characterized in that**, in case said new search criterion refers to an attribute that has already been specified by an earlier search criterion stored in said contribution stack, said earlier search criterion and all search criteria that have been
- 35 pushed onto the contribution stack afterwards are popped from said contribution stack, and said new search criterion is pushed onto said contribution stack.

1 6. Database query set-up unit according to anyone of the preceding
claims, **characterized by** means for relaxing the search constraints of a
database query which suppress at least one of said set of search criteria
5 contained in said contribution stack when said current information state
is derived.

7. Database query set-up unit according to claim 6, **characterized in
that** said means for relaxing the search constraints of a database query
select the search criteria to be suppressed according to the order of occur-
10 rence, and/or according to user profiles, and/or according to context in-
formation.

8. Database query set-up unit according to claim 6 or 7, **characterized
in that** at least the most recent search criterion stored in said contribu-
15 tion stack is suppressed when said current information state is derived.

9. Database query set-up unit according to claim 6 or 7, **characterized
in that** at least the oldest search criterion stored in said contribution
stack is suppressed when said current information state is derived.
20

10. Database query set-up unit according to anyone of claims 6 to 9,
characterized in that search criteria that are suppressed when said cur-
rent information state is derived are erased from said contribution stack.

25 11. Database query set-up unit according to anyone of claims 6 to 9,
characterized in that search criteria that are suppressed when said cur-
rent information state is derived are only erased from said contribution
stack when it turns out that the query yields a acceptable result.

30 12. Database query set-up unit according to anyone of claims 6 to 9,
characterized in that search criteria that are suppressed when said cur-
rent information state is derived are maintained within said contribution
stack.

35 13. Database query set-up unit according to anyone of the preceding
claims, **characterized in that** said search criteria are obtained by means
of an interactive system based on an artificial language, preferably based

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1 on a database query language.

14. Database query set-up unit according to anyone of claims 1 to 12,
5 **characterized in that** said search criteria are obtained from said at least one user by means of a natural language dialogue system.

15. Method for setting up database queries by combining a set of search criteria, **characterized by** the following steps:
- pushing search criteria provided by at least one user or by the system it-
10 self onto a contribution stack (1) in the order of occurrence,
- deriving a current information state (8, 10, 12) from said contribution stack (1), whereby said current information state (8, 10, 12) is formed from a subset of the set of search criteria contained in said contribution stack (1),
15 - setting up a database query corresponding to said current information state (8, 10, 12).

16. Method according to claim 15, **characterized in that** the order in which said search criteria are provided by said at least one user or by the
20 system determines a hierarchy of dependencies between said search criteria.

17. Method according to claim 15 or claim 16, further **characterized by** each time a new search criterion is provided, checking whether said new search criterion refers to an attribute that has already been specified by
25 an earlier search criterion stored in said contribution stack.

18. Method according to claim 17, **characterized by** erasing said earlier search criterion from said contribution stack, and
30 pushing said new search criterion onto said contribution stack in case said new search criterion refers to an attribute that has already been specified by an earlier search criterion stored in said contribution stack.

19. Method according to claim 17, **characterized by** popping said earlier search criterion and all search criteria that have been
35 pushed onto the contribution stack afterwards from said contribution stack, and pushing said new search criterion onto said contribution stack

- 1 in case said new search criterion refers to an attribute that has already
been specified by an earlier search criterion stored in said contribution
stack.
- 5 20. Method according to any of claims 15 to 19, **characterized by** a step of
relaxing the search constraints of a database query by suppressing at least
one of said set of search criteria contained in said contribution stack when
said current information state is derived.
- 10 21. Method according to claim 20, **characterized by** a step of
selecting the search criteria to be suppressed according to the order of oc-
currence, and/or according to context information, and/or according to
user profiles.
- 15 22. Method according to claim 20 or 21, **characterized by** a step of
suppressing at least the most recent search criterion stored in said contri-
bution stack when said current information state is derived.
- 20 23. Method according to claim 20 or 21, **characterized by** a step of
suppressing at least the oldest search criterion stored in said contribution
stack when said current information state is derived.
- 25 24. Method according to anyone of claims 20 to 23, **characterized by** a
step of
erasing those search criteria from said contribution stack that have been
suppressed when said current information state is derived.
- 30 25. Method according to anyone of claims 20 to 23, **characterized by** a
step of
maintaining those search criteria within said contribution stack that have
been suppressed when said current information state is derived.
- 35 26. Method according to anyone of claims 15 to 25, **characterized by** a
step of
obtaining said search criteria by means of an interactive system based on
an artificial language, preferably based on a database query language.

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1 27. Method according to anyone of claims 15 to 25, **characterized by a**
step of

obtaining said search criteria from said at least one user by means of a na-
tural language dialogue system.

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28. Computer program product, comprising computer program means
adapted to embody the features of the database query set-up unit as de-
fined in anyone of claims 1 to 14 or to perform the method steps as defined
in anyone of claims 15 to 27 when said computer program product is exe-
cuted on a computer, digital signal processor, or the like.

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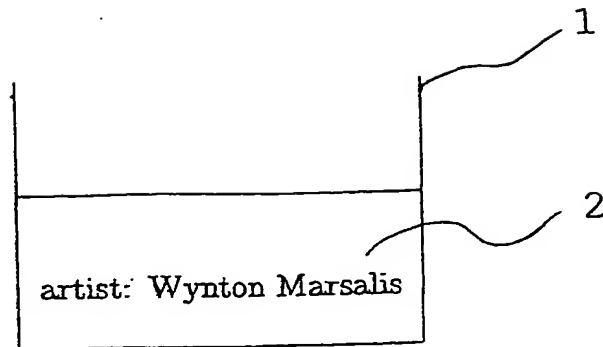


Fig. 1

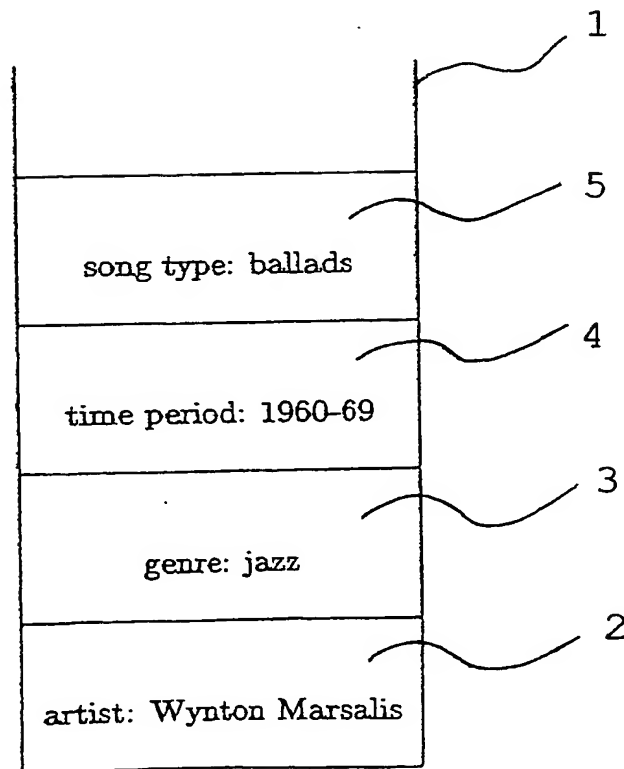


Fig. 2

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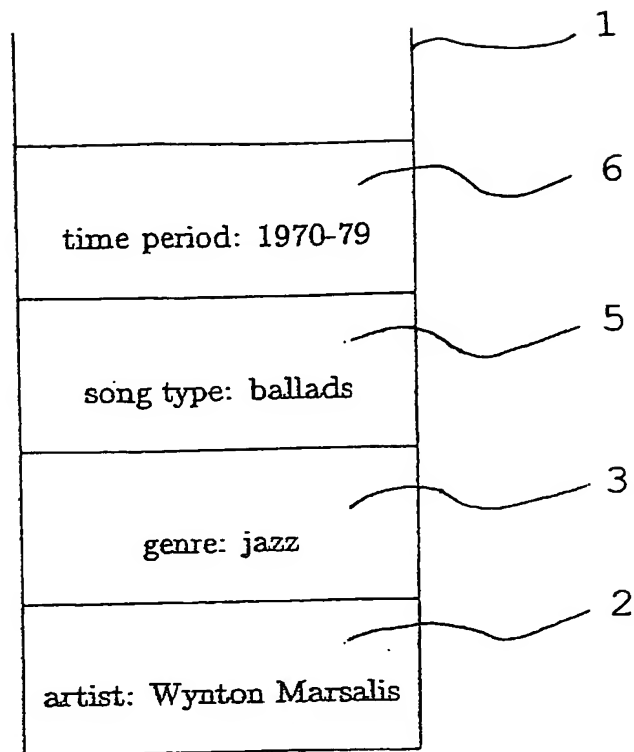


Fig. 3A

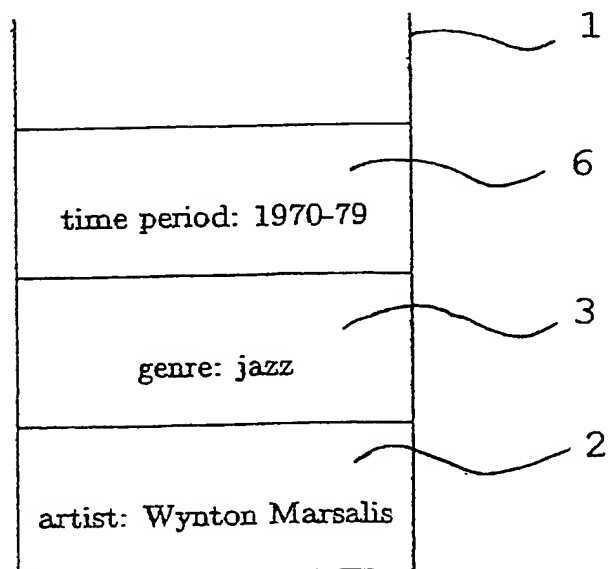


Fig. 3B

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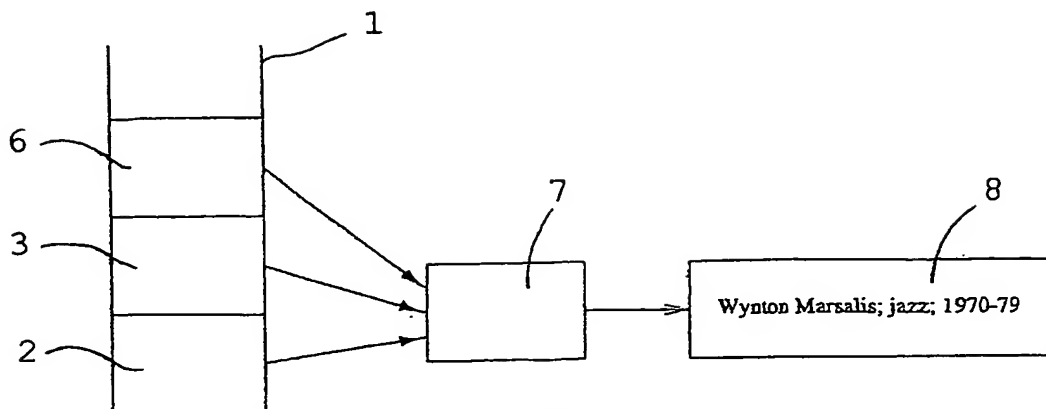


Fig. 4

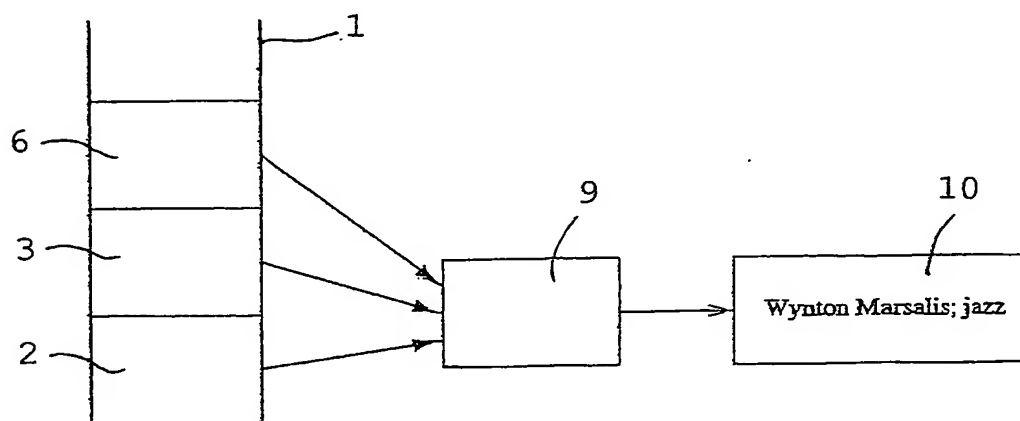


Fig. 5

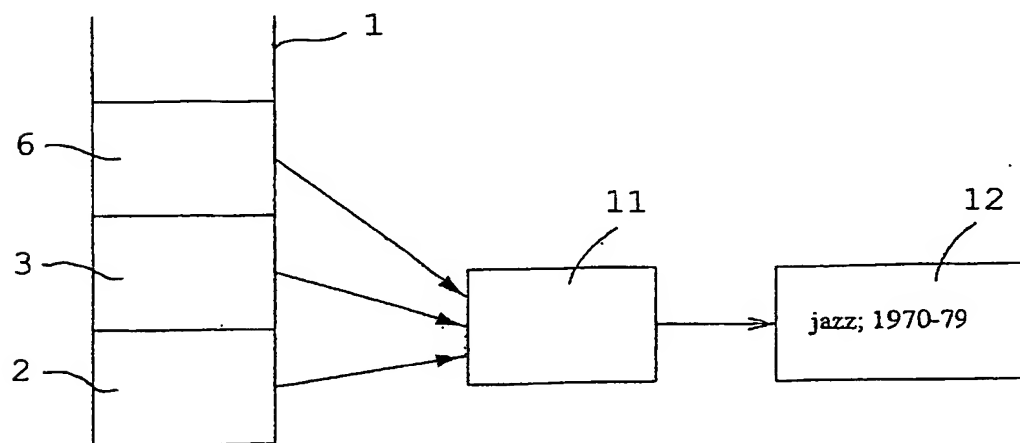


Fig. 6A

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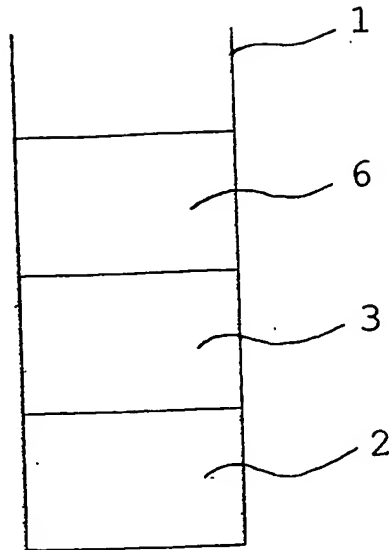


Fig. 6B

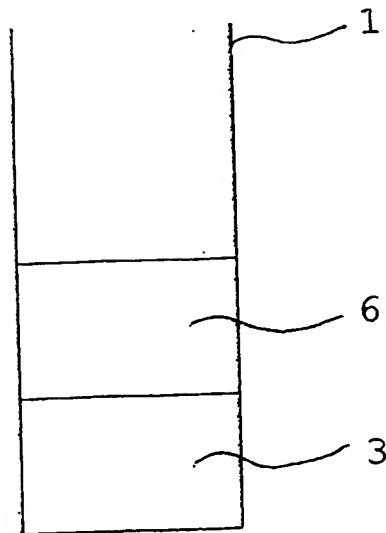


Fig. 6C

INTERNATIONAL SEARCH REPORT

Internat Application No

PCT/EP 03/09472

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06F17/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>FERRIEUX A ET AL: "AN EFFICIENT DATA-DRIVEN MODEL FOR COOPERATIVE SPOKEN DIALOGUE"</p> <p>ICSLP 94: 1994 INTERNATIONAL CONFERENCE ON SPOKEN LANGUAGE PROCESSING. YOKOHAMA, JAPAN, SEPT. 18 - 22, 1994, INTERNATIONAL CONFERENCE ON SPOKEN LANGUAGE PROCESSING. (ICSLP), YOKOHAMA: ASJ, JP, vol. 2, 18 September 1994 (1994-09-18), pages 979-982, XP000855415</p> <p>page 979, column 1 -page 980, column 1, line 42</p> <p style="text-align: center;">--- -/--</p>	1-28

☒ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

* Special categories of cited documents:

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- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *G* document member of the same patent family

Date of the actual completion of the international search

17 November 2003

Date of mailing of the international search report

28/11/2003

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INTERNATIONAL SEARCH REPORT

 Internatio ilication No
 PCT/EP /09472

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>GODDEAU D ET AL: "A form-based dialogue manager for spoken language applications" SPOKEN LANGUAGE, 1996. ICSLP 96. PROCEEDINGS., FOURTH INTERNATIONAL CONFERENCE ON PHILADELPHIA, PA, USA 3-6 OCT. 1996, NEW YORK, NY, USA, IEEE, US, 3 October 1996 (1996-10-03), pages 701-704, XP010237893 ISBN: 0-7803-3555-4 page 701, column 2, paragraph 3 -page 702, column 1, paragraph 1 page 702, column 1, paragraph 3 -page 703, column 2</p> <p>---</p>	1-28
A	<p>LUDWIG B, GÖRZ G, NIEMANN H: "An Inference-Based Approach to the Interpretation of Discourse" SPECIAL ISSUE OF THE JOURNAL OF LANGUAGE AND COMPUTATION, vol. 1, no. 2, 2000, pages 241-258, XP002244465 cited in the application * the whole document *</p> <p>---</p>	1-28
A	<p>KOVACS L ET AL: "Visualizing queries in a distributed digital library system" PROCEEDINGS OF THE EUROMICRO CONFERENCE. EUROMICRO. INFORMATICS: INVENTING THE FUTURE, PROCEEDINGS OF EUROMICRO WORKSHOP ON MULTIMEDIA AND TELECOMMUNICATIONS, XX, XX, vol. 2, 5 September 2000 (2000-09-05), pages 110-117, XP002210915 page 111, column 2; figure 1 page 113</p> <p>---</p>	1-28
A	<p>LARSSON S, COOPER R ET ERICSSON S: "menu2dialog" KNOWLEDGE AND REASONING IN PRACTICAL DIALOGUE SYSTEMS, WORKSHOP PROGRAM, IJCAI-2001, 2001, XP002244466 cited in the application * the whole document *</p> <p>-----</p>	1-28